

WHAT IS CLAIMED IS:

1                    1.        A method of reconstructing optical tissues of an eye, the method  
2 comprising:  
3                    transmitting an image through the optical tissues of the eye;  
4                    measuring surface gradients from the transmitted image across the optical  
5 tissues of the eye; and  
6                    applying a Fourier transform algorithm to the surface gradients to reconstruct  
7 a surface that corresponds to the optical tissues of the eye.

1                    2.        The method of claim 1 comprising aligning the reconstructed surface  
2 of the optical tissues of the eye with an image of the eye that was obtained during the  
3 measuring of the surface gradients.

1                    3.        The method of claim 1 or 2 comprising computing a correction  
2 ablation pattern based on the optical tissues of the eye as indicated by the Fourier  
3 reconstructed surface.

1                    4.        The method of claim 3 wherein computing a correction ablation pattern  
2 comprises deriving a proposed change in elevations of the optical tissue so as to effect a  
3 desired change in optical properties of the eye.

1                    5.        The method of claim 4 further comprising modifying the optical tissue  
2 surface according to the correction ablation pattern by laser ablation.

1                    6.        The method of claim 1 further comprising adding a mean gradient field  
2 to remove a tilt from the reconstructed surface.

1                    7.        The method of claim 1 wherein measuring the surface gradients  
2 comprises uniformly sampling the transmitted image over an aperture.

1                    8.        The method of claim 7 wherein the aperture is a pupil of the eye.

1                    9.        The method of claim 1 wherein measuring surface gradient data is  
2 carried out with a Hartmann-Shack sensor assembly.

1                    10.      The method of claim 1 wherein the surface is a wavefront surface.

1                   11.     The method of claim 1 wherein applying a Fourier transformation  
2 comprises applying a discrete Fourier decomposition and an inverse discrete Fourier  
3 transform.

1                   12.     The method of claim 1 wherein the Fourier transformation uses all of  
2 the available information in the reconstruction.

1                   13.     The method of claim 1 wherein applying the Fourier transform  
2 calculates a tomographic wavefront error map of the optical tissues of the eye.

1                   14.     The method of claim 1 wherein the image is transmitted by the optical  
2 tissues as a plurality of beamlets, wherein the surface gradients comprise an array of  
3 gradients,  
4                   wherein each gradient corresponds to an associated portion of the optical  
5 tissues of the eye, wherein each beamlet is transmitted through the optical tissues according  
6 to the corresponding gradient.

1                   15.     A method for measuring optical tissues of an eye, the method  
2 comprising:  
3                   transmitting an image through the optical tissues;  
4                   determining local gradients across the optical tissues from the transmitted  
5 image; and  
6                   mapping a wavefront error of the eye by applying a Fourier transform  
7 algorithm to the surface gradients across the optical tissues of the eye.

8                   16.     The method of claim 15 further comprising adding a mean gradient  
9 field to the wavefront error to correct for tilt.

1                   17.     The method of claim 15 wherein determining local gradients across the  
2 optical tissues is carried out by a Hartmann-Shack sensor assembly.

1                   18.     The method of claim 15 comprising creating a laser ablation treatment  
2 table based on the mapped wavefront error of the optical tissues of the eye.

1                   19.     The method of claim 18 comprising modifying the optical tissue  
2 surface according to the correction ablation pattern by laser ablation.

- 1                   20.     A system for measuring a wavefront error of optical tissue, the system  
2 comprising:  
3                   a processor;  
4                   a memory coupled to the processor, the memory configured to store a plurality  
5 of code modules for execution by the processor, the plurality of code modules comprising:  
6                   a module for transmitting an image through the optical tissues;  
7                   a module for determining local gradients across the optical tissues from  
8 the transmitted image; and  
9                   a module for mapping a wavefront error of the eye by applying a  
10 Fourier transform algorithm to the surface gradients across the optical tissues of the eye.
- 1                   21.     The system of claim 20 further comprising an image source coupled to  
2 the processor for transmitting a source image through the optical tissues of the eye.
- 1                   22.     The system of claim 20 further comprising a wavefront sensor system  
2 coupled to the processor.
- 1                   23.     The system of claim 22 wherein the wavefront sensor system  
2 comprises a Hartmann-Shack sensor assembly.
- 1                   24.     The system of claim 20 wherein the code modules further comprise a  
2 module for computing a correction ablation pattern based on the optical tissues of the eye as  
3 indicated by the Fourier reconstructed surface.
- 1                   25.     A laser system that is in communication with the system of claim 24  
2 wherein the laser system comprises a laser that is programmable to deliver a laser energy to  
3 the optical tissues according to the correction ablation pattern.
- 1                   26.     The system of claim 20 further comprising a camera to track the  
2 position of the optical tissues,  
3                   wherein the code modules further comprise a module for registering the  
4 wavefront error relative to the optical tissues.
- 1                   27.     The system of claim 20 further comprising an adaptive optical element  
2 that is coupled to the processor.

1                   28.     The system of claim 27 wherein the adaptive optical element is a  
2 deformable mirror.

1                   29.     A computer program stored on a computer-readable storage medium  
2 for measuring optical tissues, the computer program comprising:  
3                   code for transmitting an image through the optical tissues of the eye;  
4                   code for measuring surface gradients from the transmitted image across the  
5 optical tissues of the eye; and  
6                   code for mapping a wavefront error of the eye by applying a Fourier transform  
7 algorithm to the surface gradients across the optical tissues of the eye.

8                   30.     The computer program of claim 29 further comprising code for  
9 computing a correction ablation pattern based on the optical tissues of the eye as indicated by  
10 the Fourier reconstructed surface.

1                   31.     The computer program of claim 30 further comprising code for  
2 delivering a laser energy to the optical tissues according to the correction ablation pattern.

1                   32.     The computer program of claim 29 further comprising code for  
2 aligning the mapped wavefront error with an image of the optical tissues of the eye.

1                   33.     A system for measuring optical tissues of an eye, the method  
2 comprising:  
3                   means for transmitting an image through the optical tissues;  
4                   means for determining local gradients across the optical tissues from the  
5 transmitted image; and  
6                   means for mapping a wavefront error of the eye by applying a Fourier  
7 transform to the surface gradients across the optical tissues of the eye.

1                   34.     The system of claim 33 further comprising means for computing a  
2 correction ablation pattern based on the optical tissues of the eye as indicated by the Fourier  
3 reconstructed surface.

1                   35.     The system of claim 34 further comprising means for modifying the  
2 optical tissue surface according to the correction ablation pattern by laser ablation.